DRAFT

Restoration of Delta Shallow Water Habitat

Description

Shallow-water tidal habitat in the Delta has declined drastically over time because of agricultural lands reclamation, dredging of channels and bays, and erosion of remaining shallow water habitats (e.g., channel islands) by wind-driven waves, boat wakes, or high-velocity flows. Restoration of shallow water habitat in the Delta may include various means of converting existing islands or other leveed lands having elevations below sea level into shallow-water tidal habitat. Other options include converting deeper water habitat into shallow water habitat by filling the former with dredged materials; partial levee protection; and protecting existing shallow water habitats from additional erosion, dredging, or filling.

Purpose

Restoration of shallow water habitat in the Delta will improve survival and production of native fish species. Restoration would increase the amount of spawning, rearing, and feeding habitat for many Delta fishes and invertebrates, and would provide foraging habitat for wildlife.

Constraints

Restoration of shallow water habitat can be costly and could result in conversion of agricultural lands to aquatic habitat. Filling Delta channels may affect the flood-conveyance capacity of channels and filling deeper waters may constrain navigation and increase sediment loads in Delta waters. In addition, converting Delta islands into shallow water habitat would require large quantities of fill material. The use of dredged materials must address the possible existence of toxic constituents in dredged sediments.

Linkage to Other CALFED Action Categories

Restoration of shallow water habitat can be linked to Delta channel modifications, levee maintenance and stabilization, flood protection improvements, management of dredged materials, reduction of land subsidence, and threatened and endangered species protection. For example, restoration of shallow water habitat can be combined with channel modifications that reduce flow velocities to provide high-quality spawning and rearing habitat for resident fish species. Restoration of Delta riparian habitats adjacent to shallow water habitat can enhance the latter's habitat quality.

E-000332

DRAFT

Restoration of Delta Riverine Habitat

Description

The amount of high-quality Delta riverine habitat remaining has decreased over time as a result of levee maintenance, channel dredging, erosion from boat wakes, and other Delta land use activities. Restoration of Delta riverine habitat may include physical reconstruction of the river bank and shallow areas, revegetation, and placement of physical objects such as woody materials to enhance aquatic habitat value. Restoration may be combined with channel modifications and construction of levees, actions to prevent future degradation of existing and restored riverine areas, and protection and restoration of remaining channel islands.

Purpose

Restoration of riverine habitat is intended to improve degraded riverine areas by increasing the quantity and enhancing the quality of habitat for resident fishes, other organisms, and wildlife through physical enhancements of river banks and shallow areas, and through revegetation.

Constraints

Restoration of riverine habitat may cause environmental impacts on water quality and terrestrial habitat. Protection of restored riverine areas requires addressing erosion caused by channel flows, waves due to wind and/or boat wakes, and trespassing. Constraints to restoration may include the need to continue channel dredging and levee maintenance, which often requires the removal of vegetation and disposal of new dredged materials.

Linkage to Other CALFED Action Categories

Restoration of Delta riverine habitat can be combined with increased flood protection, and levee maintenance and stabilization provide multiple beneficial uses. To maximize connectivity with supporting habitats, riverine restoration can be linked to restoration of wetlands and riparian habitats, and shallow water habitat in the Delta. Increases in fish populations resulting from habitat improvements can reduce conflicts between water exports and Endangered Species Act requirements.

DRAFT

Restoration of Delta Riparian Habitat

Description

The quantity and quality of riparian woodland and scrub habitats in the Delta have decreased over time because of levee construction and maintenance, island flooding as a result of levee failure, conversion of riparian habitats to agriculture, and other human activities. Restoration of Delta riparian habitat includes improving and protecting degraded riparian woodland and scrub habitats, establishing riparian habitats in new areas, and reestablishing historic riparian habitat. This restoration could include protecting existing shaded riverine habitats to ensure no net loss of acreage and linear cover, restoring or creating riparian habitat along levees and within channel islands, developing and implementing best management practices for levee management and maintenance to maintain or increase riparian habitat, and creating and establishing riparian vegetation on channel islands in backwater areas. Restoration may also include actions to prevent future degradation of existing and restored riparian areas and protection and restoration of remaining channel islands.

Purpose

Restoration of riparian habitats is intended to increase the quantity and enhance the quality of habitat for resident and migratory wildlife, to create and maintain wildlife dispersal corridors, and to provide shaded riverine aquatic cover for fish. Protection of existing levees against erosion may also result.

Constraints

Restoring riparian habitats may be costly if easements or purchase of restoration lands in fee title is required. Protecting existing habitat and establishing new habitat areas could result in reduced Delta agricultural production and a decrease in the effectiveness of established levee maintenance programs. Developing riparian habitat on levees may be constrained by needs for levee maintenance and stabilization.

Linkage to Other CALFED Action Categories

Restoration of Delta riparian habitat can be linked to land retirement, offstream storage (e.g., on Delta islands), reduction of island subsidence, levee maintenance and stabilization, flood protection, conveyance facilities, and channel modifications. To increase their value, riparian restoration activities should also be coordinated with restoration of Delta aquatic, wetland, and terrestrial habitats. By combining restoration of a mixture of habitats, movement corridors for wildlife species can be created within the Delta. Riparian habitat restoration at the edges of Delta channels and sloughs can greatly enhance the quality of adjacent riverine and shallow water habitats.

DRAFT

Restoration of Delta Wetland Habitat

Description

Restoration of Delta wetland habitat involves improving degraded wetlands and establishing wetlands in areas that formerly supported or could now support them. Wetland restoration could include revegetating degraded wetlands; increasing the quantity and quality of seasonal, permanent, and tidal wetlands; expanding wetlands acquisition programs; and converting agricultural lands to wetlands. Restoration may also include actions to prevent future degradation of existing and restored wetlands.

Purpose

Restoration of Delta wetlands is intended to increase the quantity and enhance the quality of habitat for waterfowl and other resident and migratory wildlife, and to protect and enhance fisheries values associated with tidal marshes. Enhancement and creation of wetlands would also increase availability of brood and nesting habitat for waterfowl and other water birds that nest in the Delta, provide foraging and roosting habitat for the large number of shorebirds that annually winter or migrate through the Delta, and create habitat for several threatened or endangered species that are associated with Delta wetlands. Establishing wetlands on the interiors of below-sea-level Delta islands can also reduce the rate of island subsidence.

Constraints

Restoring wetlands may be costly if extensive grading, easements, or purchase of restoration lands in fee title is required. Protecting existing wetlands and establishing new wetlands could also result in reduced agricultural production and increased mosquito abatement costs. Restored wetlands also can attract waterfowl from other hunted areas.

Linkage to Other CALFED Action Categories

Restoration of Delta wetlands can be linked to land retirement, offstream storage (e.g., on Delta islands), land subsidence reduction, construction of conveyance facilities, channel modifications, restoration of Delta shallow water habitat, and threatened and endangered species recovery. Wetland restoration activities should be coordinated with restoring Delta riparian, aquatic, and terrestrial habitats to increase the value of wetland restoration by juxtaposing related habitats for overall ecosystem diversity.

DRAFT

Restoration of Delta Terrestrial Habitat

Description

Restoration of Delta terrestrial habitats includes improving habitat values associated with degraded uplands and agricultural lands and establishing new uplands in areas that formerly supported or could now support upland habitats. This restoration could include protecting existing uplands and maintaining production of crop types, such as corn, that provide high wildlife values; revegetating levees and fallowed croplands; and establishing oak woodlands on areas with mineral soils.

Purpose

Remaining upland habitat in the Delta is primarily associated with levee slopes and fallow croplands. Developing grassland habitats on levee slopes and permanently fallow land would provide nesting habitat for ducks, and nesting and foraging habitat for other wildlife species that use grasslands. Establishing oak woodlands on suitable soils would also provide nesting and roosting habitat for raptors and songbirds, and would increase the diversity of wildlife species that use Delta islands. Much of the historic wintering waterfowl habitat in California has been lost as a result of converting wetlands to other land uses. Croplands in the Delta now provide foraging habitat for a major segment of the Pacific Flyway's wintering waterfowl population. Managing croplands to sustain or increase the production of high-value waterfowl food crops and implementing practices that make food crops more available to waterfowl would increase the value of the Delta as a waterfowl wintering area.

Constraints

Restoring uplands may be costly if easements or purchase of restoration lands in fee title is required. Protecting existing uplands and establishing new uplands could result in reduced agricultural production. An increase in funding for existing conservation easement programs could be required in order to effectively encourage management practices on agricultural lands that would increase the quantity and quality of foraging habitat for waterfowl wintering in the Delta. Adjacent farmers may be adversely affected if they do not want waterfowl foraging on their lands.

Linkage to Other CALFED Action Categories

Restoration of Delta uplands can be linked to land fallowing, instream storage, reduction of land subsidence, levee maintenance and stabilization, threatened and endangered species protection, and preservation of agricultural lands and/or their water supplies. Terrestrial habitat restoration can also be linked to restoring Delta riparian and Delta wetland habitats.

DRAFT

Restoration of Upstream Anadromous Fish Habitat

Description

Anadromous fish habitat has declined drastically over time in the Central Valley rivers because of human activities in the watershed. Restoration of anadromous fish habitat upstream of the Delta in the rivers and tributary streams may include restoring flows to rivers and tributaries; protecting, enhancing, and restoring migrating, spawning, rearing, and holding habitat; developing management plans; modifying hatchery practices; improving law enforcement; and conducting monitoring programs.

Purpose

Restoration of anadromous fish habitat upstream of the Delta in the rivers and tributary streams will improve anadromous fish production in the Central Valley. Restoration would increase the amount of spawning, rearing, and migration habitat in rivers and tributaries.

Constraints

Restoring instream flows to rivers and tributaries will reduce water available locally for out-of-stream uses. Increasing instream flows in tributaries may increase the flood risk in rivers and tributaries, as well as downstream. Restoring habitats may constrain some uses of stream side habitats (such as grazing) to protect water quality and spawning bed conditions. Focusing planning efforts on anadromous fish restoration in some watersheds may restrict other activities and uses.

Linkage to Other CALFED Action Categories

Restoration of upstream anadromous fish habitat can be linked to restoration of upstream riparian habitat and upstream wetland habitat. Such restoration also can be linked to improvements in fish passage and migration, fish screens, fish behavioral barriers, diversion reductions, changes in location and flow conditions of diversions, threatened and endangered species protection, and adaptive management strategies. Restoration of upstream anadromous fish habitat can be combined with fish passage and migration improvements, modification of diversion patterns and locations, and Delta inflow/outflow/export management to increase populations of anadromous fish species.

E-000337

DRAFT
Restoration of Upstream Riparian Habitat

Description

Restoration of riparian habitat along rivers and tributaries upstream from the Delta may include restoring flows that are more supportive of riparian vegetation, protecting riparian vegetation from grazing animals, planting riparian vegetation, and purchasing riparian corridors along watercourses.

Purpose

Because of human activities in the watershed, riparian habitat has declined drastically over time along Central Valley rivers and streams . Restoration of riparian habitat in rivers and tributaries upstream from the Delta will improve anadromous fish production in the Central Valley by providing feeding habitat for young fish and by reducing water temperatures. In addition, riparian habitat restoration would increase the quality of rearing and migration habitat for anadromous fish in rivers and streams by producing shade and physical cover along the water's edge. Therefore, riparian habitat restoration could potentially improve survival and production of wild anadromous fish populations within the Basin.

Constraints

Riparian planting programs are costly and restoring riparian habitat along rivers and streams may require limiting land uses, such as grazing, along watercourses. In addition, increasing instream flows to benefit desirable riparian vegetation may restrict diversions of water for other uses, such as agricultural irrigation.

Linkage to Other CALFED Action Categories

Restoration of upstream riparian habitat can be linked to restoration of upstream anadromous fish habitat and upstream wetlands habitat. Upstream riparian restoration can also be linked to watershed management, improvements for fish passage and migration, changes in diversion timing patterns, changes in locations of diversions, and adaptive management strategies for anadromous fish populations. Restoration of upstream riparian habitat can be combined with restoration of upstream anadromous fish habitat (e.g., spawning beds), fish passage and migration improvements, and Delta inflow/outflow/export management to increase the populations of anadromous fish species.

DRAFT

Restoration of Upstream Wetlands Habitat

Description

Restoring wetland habitat along the margins of rivers may include expanding floodplains by modifying or removing levees, protecting and restoring existing wetlands in floodplains, controlling in-channel aggradation, and modifying existing floodways (e.g., Sutter and Yolo bypasses). In addition, new wetlands can be constructed using discharges from agriculture or urban wastewater treatment facilities.

Purpose

Wetland habitat along the margins of the rivers has declined drastically as a result of channelization, levee construction, bank protection, and other activities. Restoration of wetlands upstream from the Delta can improve wetland and wildlife habitats in the floodplains of the Sacramento and San Joaquin Rivers. In addition, seasonal wetlands can provide rearing habitat and migration routes for fry salmon during winter and spring.

Constraints

Restoring wetland habitat along the rivers and floodway corridors can conflict with existing land uses in some areas and could potentially affect flood conveyance capacity and flood protection. If required to implement wetland restoration, levee modification and construction along rivers would be costly.

Linkage to Other CALFED Action Categories

Restoration of upstream wetland habitat can be linked to restoration of upstream anadromous fish habitat and upstream riparian habitat. In addition, upstream habitat restoration can be linked to watershed management, channel modifications, groundwater banking and management, management of agricultural drainage, and management of urban/industrial drainage. For example, agricultural irrigation tailwater and effluent from urban wastewater treatment plants can be managed and used to restore wetland habitats. Restoration of upstream wetland habitat can be combined with anadromous fish habitat restoration and fish passage and migration improvements to increase populations of anadromous fish species.

DRAFT

Threatened and Endangered Species Recovery

Description

The Delta supports a relatively large number of species listed as threatened or endangered under the Federal and State Endangered Species Acts (ESAs). These include aquatic species (Delta smelt), invertebrates (valley elderberry longhorn beetle), reptiles (giant garter snake), birds (Swainson's hawk), and mammals (salt marsh harvest mouse). Actions to recover these species from threatened or endangered status may include gathering comprehensive data on their occurrence, habitat requirements, and life histories; monitoring populations; restoring and protecting habitats for individual species; implementing a regional habitat conservation plan (or plans) for the Bay and Delta that addresses one or several species; and acquiring funding for recovery actions from state and federal agencies.

Purpose

Actions to protect and enhance populations of threatened and endangered species in the Delta are intended to assist in stabilizing and recovering these populations from threatened or endangered status. If species populations can be recovered adequately, the integrity, diversity, and sustainability of the Bay-Delta system will be enhanced and the ESAs will provide less constraints on management of all resources in the Delta.

Constraints

Actions associated with recovery of listed species could require modifications of many activities on the Delta. For example, the actions could require that lands be set aside as habitat reserves for individual species or for restoration of their habitats, that water supply uses be constrained to protect aquatic species, and that levee maintenance activities be modified to retain riparian habitat important to individual species (e.g., elderberries for the valley elderberry longhorn beetle). Constraints to threatened and endangered species recovery could result from any activity or use of Delta resources that degrades or removes the habitats that these species use.

Linkage to Other CALFED Action Categories

Recovery of threatened and endangered species can be linked with restoring Delta and upstream habitats on which the species depend, establishing integrated habitat management programs, Delta inflow/outflow/export management, fish migration and passage improvements, modification of diversion patterns, fish screens, installation of barriers to fish movement, and adaptive management strategies. As populations of threatened and endangered species grow and are potentially considered recovered, conflicts between various Delta land and resource uses and ESA compliance will be reduced.

DRAFT

Establishment of Integrated Habitat Management Programs

Description

The Delta is a large area with numerous organizations and agencies working to accomplish various habitat management goals. Integrating the habitat management programs among these various agencies would allow for more integrated management of terrestrial and aquatic resources in the Delta and upstream areas of the Delta watershed. Integrated habitat management programs may include developing regional management goals, developing cooperative agreements concerning priorities for habitat restoration and enhancement, methods to combine agency funding, or developing a coordinated resource management plans. Integrated habitat management programs for the Delta or upstream habitats could also draw on previous efforts to implement Habitat Conservation Plans and Natural Community Conservation Plans to protect biodiversity.

Purpose

Establishment of integrated habitat management programs is intended to increase the efficiency and success of habitat management actions that would enhance the integrity and sustainability of the Bay-Delta system. Actions now taken by various resource management and regulatory agencies are sometimes not compatible and may not support each other. Integrated management programs could ensure that management goals and activities are compatible and supportive of each other and that resources can be pooled to achieve greater results.

Constraints

Establishing integrated habitat management programs may require extensive coordination and consultations among authorities and agencies that now have distinct jurisdictions and objectives. These entities may need to modify their management priorities and goals in such a way as to be compatible with the goals of the integrated program. Such organizational restructuring and reprioritizing may be complex and difficult to achieve.

Linkage to Other CALFED Action Categories

Integrated habitat management programs can be linked to all types of habitat restoration in the Delta and upstream, threatened and endangered species recovery, improvements to flood protection, reducing land subsidence, and establishing floodways and meander belts. Other actions that can provide opportunities for habitat restoration, such as Delta channel modifications, improvement of conveyance facilities, offstream water storage in the Delta, and levee maintenance, can be implemented for greater overall benefit as a result of increased integration between responsible resource management and regulatory agencies.

DRAFT

Acquisition of Long-Term Water Supplies for Fish and Wildlife

Description

Long-term water supplies for fish and wildlife can be acquired through contractual mechanisms to obtain water from sources such as reservoir storage releases, groundwater banking, and long-term water transfers, or through purchase and lease of agricultural water. Water could be obtained from any potential source of inflow to the Delta, particularly the Sacramento River basin.

Purpose

Long-term water supplies for fish and wildlife would provide greater flexibility for managing Central Valley fish and wildlife resources and provide greater habitat stability for fish survival, growth, and reproduction. Additional water supplies could be used to improve minimum instream flow conditions, provide Delta inflow or outflow, increase pulse flows to enhance downstream and upstream migrations, decrease riverine water temperatures, minimize flow fluctuations below dams, enhance wildlife refuge water supplies, and promote riparian vegetation restoration. Properly timed water deliveries from upstream watershed sources could benefit anadromous and native fish populations in tributaries, mainstem rivers, the Delta, and the Bay, as well as water-dependent wildlife resources in the Central Valley. Water transferred from Delta water right holders could provide additional Delta outflow and minimize fish losses from entrainment and impingement at existing diversions.

Constraints

Numerous economic, legal, and institutional constraints exist, such as application of existing water rights laws and area-of-origin statutes. Depending on water supply and user need, the price of water can vary tremendously from $35 to $125 per acre-foot . Acquiring long-term water supplies is costly, and competition for long-term water supplies is intense between environmental, urban, and agricultural user groups. The U.S. Bureau of Reclamation (through the Central Valley Project Improvement Act), California Department of Water Resources, and Delta exporters are independently seeking to purchase large quantities of water, primarily for fisheries-related enhancement.

Linkage to Other CALFED Action Categories

Long-term water acquisition for fish and wildlife can be linked most directly to water transfers and thereby indirectly to land retirement and fallowing, groundwater banking and management, long-term contingency planning, Delta inflow/outflow/export management, and construction of offstream storage. Long-term water acquisition could also be linked with most other water management actions and restoration of all types of habitat in the Delta and upstream to increase the overall benefits to habitats in the Bay-Delta system.

Delta Inflow/Outflow/Export Management

Description

Water management in the Delta primarily involves manipulation of allowable exports as a function of required Delta outflow or as a specified fraction of Delta inflow. For example, the 1995 Water Quality Control Plan (WQCP) established monthly minimum outflows and maximum export/inflow ratios. The WQCP also specified San Joaquin River flows to assist downstream migration of salmon and establish exports limited to a specified fraction of this San Joaquin River flow. While Delta inflows are partially controlled by upstream reservoir releases, the primary management of Delta operations are the monthly or daily allocation of Delta inflows for in-Delta diversions (consumptive use), Delta exports, and Delta outflows. The CALFED Framework Agreement in June 1994, established a Delta operations coordination group that has been delegated authority to recommend changes in the allowable exports based on available ("real-time") fish monitoring information. Future changes could include establishment of a formal Delta watermaster to manage Delta inflow/outflow/export.

Purpose

Carefully managing allocation of Delta inflows between Delta outflow and Delta exports could provide many potential environmental benefits. It may be possible to provide improved drinking water quality by controlling salinity intrusion with increased outflows, or by reducing water supply exports during the initial flush of runoff and agricultural drainage following major rainfall events. Many possible fisheries benefits can be achieved by managing the fraction of Delta inflow that can be exported (e.g., improving downstream transport of migrating salmon or survival of early life-stages of fish that spawn within Delta channels or in upstream areas).

Constraints

Predictability of the Delta inflow water supply is the primary constraint on management of outflow and exports. Managing exports in conjunction with providing aquatic habitat benefits is difficult because of uncertainties in the risk of a reduced water supply and in the fisheries benefits that would be achieved.

Linkage to Other CALFED Action Categories

Management of Delta inflow/outflow/export will be more effective if it is linked with flow and/or fish barriers to provide a wider range of water transport and fish transport/migration controls. Managing Delta flows can be directly linked to new or expanded instream or offstream storage, groundwater banking and management, construction and improvement of conveyance facilities, water transfers, and water resources data and information management.

DRAFT

Fish Passage and Migration Improvements

Description

Fish passage and migration improvements may include improving flows for downstream migrating juveniles; removing or minimizing effects of migration barriers, such as diversion dams; improving fish passage where blocked or hindered by natural barriers; increasing flows in hydropower bypass areas; providing attraction flows for upstream migrating adult anadromous fish in the estuary and rivers; and minimizing effects of migration barriers, such as the dissolved oxygen barrier in the San Joaquin River near Stockton.

Purpose

Upstream and downstream passage of anadromous fish has been hindered or blocked by natural and human events and activities. Fish passage and migration improvements will increase the chances that upstream-migrating adult salmonids will reach spawning rivers and streams and that downstream-migrating juvenile and adult salmonids will reach the lower rivers, estuary, and ocean. Improving flow conditions and reducing problems with water quality and physical barriers will potentially increase the numbers of anadromous fish that reach spawning areas and the numbers of juveniles that reach the estuary and ocean, ultimately increasing the overall production of the populations.

Constraints

Increasing flows during upstream and downstream migration periods may reduce availability of water supplies for urban and agricultural purposes. Modifications to diversion dams or other physical barriers are very costly and, at times, may not be technologically feasible. Improving fish passage by flow alterations and modifications of migration barriers can be costly.

Linkage to Other CALFED Action Categories

Improving fish passage problems can be linked to restoration of upstream anadromous fish habitat; upstream riparian habitat, and upstream wetland habitat. Solutions to fish passage and migration problems can also be linked to modifications of water project operations, instream storage, channel modifications, flow barriers, Delta inflow/outflow/export management, management of urban/industrial drainage, changes in diversion timing, and changing locations of diversions. Adaptive management strategies should be used with real-time monitoring to optimize the effectiveness of these improvements. Fish passage and migration improvements can be combined with restoration of upstream anadromous fish habitat to increase populations of these fish species.

DRAFT

Changes in Locations of Diversions

Description

Anadromous and resident fish (juveniles, eggs and larvae) and other aquatic organisms are lost through entrainment at diversions in the Bay, Delta, rivers, and tributaries. The locations of diversions partially determine the extent of potential losses of fish at the diversions. Relocation of certain diversions to sites with different flow conditions could reduce the losses of fish at these diversions. For example, relocating the State Water Project (SWP) diversion at Clifton Court Forebay to Italian Slough, during specific periods of time when species of concern are found to be adjacent to the forebay intake gates could reduce losses of vulnerable fish to predators in Clifton Court Forebay. Moving agricultural diversions on Sacramento River tributaries (such as Big Chico Creek) to locations where diversions would comprise a much smaller proportion of total flow, could reduce the potentially high losses of young salmon. Also, relocating the Central Valley Project and SWP diversions to locations more favorable for screening could reduce losses of important fish species.

Purpose

Changing locations of specific diversions in the Bay, Delta, rivers, and tributaries to sites where flow conditions make fish less vulnerable to entrainment could reduce losses of critical life-stages of salmon, steelhead, striped bass, and other aquatic organisms.

Constraints

Changing locations of diversions and installation of new diversion facilities and equipment are costly. New diversion facilities, and conveyance facilities between the new diversions and existing distribution systems, will require environmental assessments for the impacts of those facilities.

Linkages to Other CALFED Action Categories

Changing locations of diversions can be linked to improvement and construction of conveyance facilities, modifications of water project operations (e.g., to reduce entrainment during particularly sensitive periods), development of offstream storage to reduce need for continuous diversions, Delta inflow/outflow/export management, improvements for fish passage and migration, fish screens, predator removal and control, and behavioral barriers to fish movement. Finally, an adaptive management strategy, using real-time monitoring for the presence or absence of critical fish life-stages, should be used to optimize the operational effectiveness of any relocated diversion facility.

Changing the locations of diversions can be combined with modification of water project operations and delta inflow, outflow and export management to enhance fish passage and migration improvements.

Increased Diversion Capacity

Description

Increasing diversion capacity would require new or enlarged diversion facilities and new or enlarged canals or pipelines for delivering water from the point of diversion to the place of use. Obtaining permits to allow use of additional pumps at the State Water Project's Banks Pumping Plant would enable full-capacity use of the California Aqueduct during hydrologic periods when exportable water is available in the Delta. The California Department of Water Resources has proposed additional diversion facilities at Clifton Court Forebay as part of the Interim South Delta Program to allow increased diversions with less environmental impacts. The U.S. Bureau of Reclamation is experimenting with diversion pumps at the Red Bluff Diversion Dam that may be required to divert water when the dam gates remain open for fish migration.

Purpose

Increased diversion capacity can be used to more effectively manage water supply during seasonal periods of excess water. Improved diversion and conveyance facilities can be used to divert additional water supply during brief periods of high flows so that diversions during low flows can be reduced accordingly. Increased diversion capacity may also be needed to facilitate water transfers through the Delta over selected, short periods to minimize fish impacts.

Constraints

The cost to construct additional diversion facilities or improve existing facilities to increase capacity can potentially be very high. In addition, the environmental impacts of new facilities may be substantial. However, replacing existing facilities with new diversion designs that include improved fish screens or other environmental mitigation features may reduce impacts. Increased diversions during wet periods may produce fewer environmental impacts than existing diversions during dry periods.

Linkage to Other CALFED Action Categories

Increasing diversion capacity can be linked to improvements in fish screen designs, improved fish salvage operations, predator removal and control, modification of diversion-timing patterns, changes in diversion locations, and Delta inflow/outflow/export management to reduce overall impacts of diversions on aquatic resources. Increased diversion capacity can also be linked to groundwater banking and management, off-stream storage, water transfers, construction and improvement of conveyance facilities, and water resources data and information management to better use available water supplies and increase water supply reliability with less impacts on aquatic resources of the Bay-Delta system.

DRAFT

Fish Screens

Description

Entrainment of fish at water diversions used for agricultural, urban, and industrial uses in the Bay, Delta, rivers, and tributaries has contributed substantially to reduced fish populations in the Bay-Delta system. Fish screens can be provided or improved by consolidating existing small water diversions and screening the larger, combined diversion; optimizing screening efficiency at existing screens; and designing, installing, and operating effective screens at unscreened diversions to reduce entrainment and impingement of fish.

Purpose

Installing fish screens at unscreened diversions and improving fish screen systems at screened diversions will greatly reduce losses of vulnerable fish life-stages at water diversions in the Bay, Delta, rivers, and tributary streams and potentially lead to improvements in survival and population abundance.

Constraints

In many cases, technology is not available to protect vulnerable life-stages of some fish populations in the estuarine environment. Additional research and demonstration studies are necessary to confirm the feasibility and effectiveness of suggested, new screen designs. Screening existing unscreened diversions and improving screening systems at screened diversions can be very costly to install, operate, and maintain.

Linkages to Other CALFED Action Categories

Fish screening can be linked to diversion reductions, improving fish salvage operations at screening facilities, changes in locations of diversions, modifications of water project operations, improvement and construction of conveyance facilities, improvements for fish passage and migration, installation of barriers to fish movement, predator removal and control, and threatened and endangered species protection. Fish screening installations and improvements should use an adaptive management strategy consisting of real-time monitoring and incremental improvements in design and operational aspects to reduce impacts to aquatic resources of the Bay-Delta system.

DRAFT

Installation of Barriers to Fish Movement

Description

Fish barriers can consist of either physical barriers such as gates and screens or behavioral barriers such as acoustic devices that alter fish swimming behavior to direct them away from predominant flow patterns. Behavioral barriers do not block water movement and navigation as physical barriers do. Fish barriers are being considered for the upper and lower ends of Old River and at other Delta locations where substantial flows are directed away from historical migratory pathways by export pumping. For example, behavioral barriers are being considered to prevent fish from moving toward the central Delta with flows from the Sacramento River through the Delta Cross Channel, Georgiana Slough, and Three-Mile Slough. Additionally, the Delta Cross Channel gates can be operated to form a physical barrier to fish transport toward the central Delta when critical life-stages of fish are moving down the Sacramento River near the cross channel.

Purpose

Installation of fish barriers in the Delta could reduce the movement of fish toward the south Delta pumping plants and help direct the fish downstream to the Bay, thus reducing losses of anadromous fish to Delta diversions. By directing outmigrating fish through the Delta, fish barriers would increase the flexibility of export pumping while reducing losses of anadromous fish populations. Physical barriers, but not behavioral barriers, may also improve water circulation and quality. Physical barriers can also be installed at upstream locations to prevent anadromous fish from straying into uninhabitable watercourses (e.g., the San Joaquin River above the Merced River).

Constraints

Installations of fish barriers in the Delta can have logistical and technical problems. A barrier in one location may create problems at other locations. For example, a physical barrier at the head of Old River to keep San Joaquin River salmon from moving into Old River in the spring may block recreational navigation or transport of flows important for water quality. Also, construction and operation of physical barriers may be costly. Because of uncertainties in the performance of behavioral barriers, such barriers should be installed using adaptive management strategies in conjunction with real-time monitoring. Operation and maintenance of behavioral barriers would be labor intensive and costly.

Linkages to Other Action Categories

Installation of barriers to fish movement can be linked to other improvements for fish passage and migration, installation of fish screens, predator removal and control, changes to locations of diversions, and adaptive management strategies. Barriers to fish movement can also be linked to modifications of water project operations, channel modifications, improvements to conveyance facilities, Delta inflow/outflow/export management, and management of agricultural drainage in the south Delta to produce greater overall benefits for anadromous fish populations.

E-000348

DRAFT
Adaptive Management Strategies

Description

Adaptive management strategies consist of incrementally implementing changes to facilities and their operations to better meet integrated resource management objectives. After each incremental step, the extent to which those objectives and performance measures are attained is monitored and further incremental adjustments in the facilities or their management are made to better meet the overall objectives. Adaptive management strategies can be applied to ecosystem responses, such as habitat conditions or fish populations; to water quality conditions; and to water supply flow objectives. A necessary component of an adaptive management strategy are scientifically based predictive and monitoring tools to adjust system design or operations to better match system responses to management objectives.

Purpose

Implementing programs or facility operations on a stepwise basis allows managers to initiate and then adapt a program to better meet objectives based on the responses observed to each step. This approach allows actions to proceed in attempting to improve resource conditions while avoiding commitments of large amounts of material and personnel to uncertain or potentially ineffective programs.

Constraints

Adaptive management strategies require establishing long-term goals, objectives, and performance measures and extended monitoring periods to allow sufficient time to test and gain insight from a stepwise process of action and adaptation. These strategies require a commitment to careful monitoring and analysis to compare system responses to established objectives. To gain acceptance, an adaptive management strategy may require a predetermined series of actions in response to possible scenarios to be agreed upon in advance.

Linkages to Other Action Categories

Adaptive management strategies should be accompanied by real-time monitoring and water resource data and information management. Adaptive management strategies can be applied to actions such as modifications of water project operations, operation of flow barriers to manage fish populations or water quality conditions, management of agricultural drainage, improvements for fish passage and migration, nutrients input management to increase aquatic food web productivity, establishment of barriers to fish movements, and fish stock management programs.

DRAFT

Desalination

Description

Desalination is the process by which water that has a high salt content is treated to reduce salt concentrations and produce potable water. Several different processes are available to desalinate water, including distillation and reverse osmosis. Desalination can be used to produce drinkable water from seawater, brackish water, or saline groundwater. Because of the high energy costs associated with current technologies, desalination is most cost effective for desalting low-salt groundwater and for municipal recycling. Successful groundwater and municipal desalination projects are currently operating in California.

Purpose

Desalination is generally identified as a potential solution for water supply limitations in coastal areas and Southern California. Large-scale desalination of seawater could provide a major source of water to Southern California, providing an alternative to diversions through or around the Delta. This substitute supply could reduce water demands on the Delta, reducing demands for Delta exports and benefitting Delta water quality and ecosystem quality. Desalination could also be used to improve the quality of drinking water taken from the Delta during periods of salinity intrusion.

Constraints

Desalination is energy-intensive, resulting in high cost for each acre-foot of potable water produced. Implementation of a large-scale desalination program could require construction of new power sources. Withdrawal of seawater and its associated effects on marine life are a potential concern, and desalination produces a waste product of highly concentrated brine that must be disposed.

Linkage to Other CALFED Action Categories

Desalination can be linked to long-term drought contingency planning, water conservation, water reclamation, groundwater banking and management, management of agricultural drainage, water pricing, and establishment of institutional arrangements for long-term water management. Combining desalination, water reclamation, and water conservation with long-term drought contingency planning can reduce the magnitude of each element needed, thus reducing the costs and impacts associated with each.

DRAFT

Water Conservation

Description

Water conservation focuses on reducing the demand for water by increasing the efficiency with which water is used in agricultural, industrial, and urban settings. Water conservation can include implementation of Urban Best Management Practices and Agricultural Efficient Water Management Practices such as increasing the efficiency of irrigation, reducing consumption of water in industrial processes, and installing low-flow plumbing devices in homes. Water conservation can also be encouraged institutionally, such as by restricting lawn watering to certain days and times and by implementing policies such as conservation pricing and financial incentives. Water conservation is actively implemented in many parts of the state.

Purpose

Implementing water conservation measures could substantially reduce water needs, thereby potentially reducing the need for water from the Delta and the necessity of developing new water facilities and sources. For example, the Metropolitan Water District of Southern California estimates that demand for water in Southern California could be reduced by 13% through water conservation.

Constraints

Implementing large-scale water conservation programs would be expensive to individuals, businesses, and public agencies and can dislocate existing business operations and arrangements. Strict water conservation also tends to reduce flexibility to reduce water consumption in years of extreme drought.

Linkage to Other CALFED Action Categories

Implementation of water conservation programs can be linked to water reclamation programs, long-term drought contingency planning, watershed management, improvements to conveyance facilities, groundwater banking and management, management of agricultural drainage, management of urban/industrial drainage, adjustments of water rates to reflect all of the costs of providing water, and establishment of institutional arrangements for long-term water management. For example, water conservation, in combination with water reclamation, groundwater banking and management, and adjustment of water rates to reflect all of the costs of providing water can reduce the need for water exports from the Delta. Reductions in the need for exports may result in reduced exports which, in turn, can lead to improvements in aquatic habitat conditions (for example, Delta outflow) and in water quality for in-Delta beneficial uses.

DRAFT
Water Reclamation

Description

Water reclamation is the process by which water that has been previously used for one purpose is treated to levels established by federal and state standards, depending on the subsequent use, and reused. For example, many agencies are reclaiming treated wastewater and using the reclaimed water to irrigate crops, urban landscapes, and median strips or for industrial applications such as power plant cooling and process water for paper mills. Most reclaimed wastewater is used to recharge ground water basins for later extraction and use or to repel saltwater intrusion into aquifers.

Purpose

Water reclamation and reuse is generally considered as a way to reduce water demands for water imports by reusing local supplies. Implementation of major water reclamation programs, such as those currently underway in Southern California, could reduce demands on the Delta by providing an alternative source to diversions through or around the Delta. This reduction of Delta export demand would benefit Delta water quality and ecosystem quality.

Constraints

Depending on the type of reuse scenario, reclamation can be moderately expensive and can require parallel transmission and distribution systems to ensure separation of potable and reclaimed water. Groundwater recharge, however, is generally cost-effective because large amounts of reclaimed water can be reused with relatively minimal capital costs. The use of reclaimed water often requires an extensive public education program to deal with public perceptions on health issues. Use of reclaimed water is highly regulated by California law and extensive studies of health effects in areas of high reuse have shown no measurable adverse effects.

Linkage to Other CALFED Action Categories

Reclaimed water could be used to enhance or create new habitat areas for fish and wildlife. For example, wastewater treatment plant effluent can be used as a water source for constructed wetlands. Reclaimed water could also be used as an alternate source for some activities that currently use fresh water, such as irrigation and groundwater recharge, thereby making more fresh water available for other uses. Water reclamation, in combination with water conservation, groundwater banking and management, and adjustment of water rates to reflect the appropriate cost of water, can reduce the demand for water exports from the Delta. Reductions in Delta exports can result, in turn, in improvements in aquatic habitat conditions (e.g., Delta outflow) and in water quality for in-Delta beneficial uses.

E-000352

DRAFT

Land Retirement and Fallowing

Description

Land retirement or temporary land fallowing consists of taking actively farmed and irrigated land out of production so that the water used to irrigate that land can be used for some other beneficial use. Land retirement is often suggested for farmlands that have problems with drainage that collects in saline sumps or contaminates offsite locations. Temporary land fallowing is a means by which to deal with shortages of irrigation water in drought periods.

Purpose

Temporary land fallowing or permanent land retirement could make substantial amounts of water available for other uses, thereby reducing Delta exports and benefitting Delta water quality and ecosystem quality. Land retirement could also reduce agricultural drainage problems. Retired agricultural lands can be managed for their value as wildlife habitat.

Constraints

Large-scale land retirement or temporary fallowing could have local or regional economic consequences. Fallowed land would not require labor and materials for farming, causing secondary effects on "third party" businesses and local populations that depend on agricultural activities for income. Ownership of water made available through fallowing may also be raised as an issue. Permanent land retirement from production may require purchase of agricultural lands.

Linkage to Other CALFED Action Categories

Temporary land fallowing or retirement programs can be linked to management of agricultural drainage, water conservation, watershed management (e.g., watershed-scale planning of appropriate land uses), water transfers (from areas of fallowed land to other areas), groundwater banking and management, long-term drought contingency planning, and establishment of institutional arrangements for long-term water management. For example, temporary land fallowing could be combined with water transfers, groundwater banking and management, and water conservation to improve the reliability of water supplies and achieve stabilization of groundwater aquifers. Permanent land retirement could be combined with Delta and upstream habitat restoration, and establishment of floodways and meander belts to improve ecosystem diversity and sustainability of the Bay-Delta system.

DRAFT

Watershed Management

Description

Watershed management consists of various activities and measures to improve land management practices to improve water quality and increase water supplies produced within a watershed. Maintaining appropriate vegetation cover, protecting riparian zones from disturbance, and avoiding soil disturbance that initiates erosion are practices that protect downstream water quality. In headwater areas subject to snowpack accumulation, vegetation manipulation can be used to delay melting of the snowpack and thereby possibly increase total water yield. Maintaining appropriate vegetation cover in areas subject to precipitation can also delay runoff and contribute to total yield. Delayed runoff is more easily stored in reservoirs or recharged to groundwater than is runoff during peak flood-control periods.

Purpose

In watersheds around south-of-Delta storage reservoirs, watershed management practices are aimed primarily at maintaining water quality for urban and industrial uses, whereas watershed management in areas tributary to the Delta can contribute to enhancing water yields in addition to protecting water quality. Watershed management also protects the long-term reliability of reservoirs and conveyance facilities by reducing sedimentation.

Constraints

Watershed management is relatively inexpensive compared with other means by which to enhance supplies or maintain water quality. However, watershed management is often constrained by the lack of uniform land ownership across the watershed areas. Large watersheds in the Sierra Nevada Mountains under the sole management of the U. S. Forest Service may offer the best opportunities for coordinated programs to increase water yields and protect water quality by manipulating vegetation.

Linkages to Other CALFED Action Categories

Watershed management can be linked to restoring upstream riparian, wetland, and anadromous fish habitats; groundwater banking; water transfers (from areas of enhanced yields to use areas); instream and offstream storage facilities; and Delta inflow/outflow/export management,. For example, improved watershed management can benefit wildlife and fishery habitat conditions within watersheds, as well as benefit anadromous fish habitat downstream, by improving the quality and extending the duration of run-off. Watershed management can also be linked to groundwater management to enhance recharge of aquifers for groundwater banking and conjunctive use.

New or Expanded Instream Storage

Description

Instream storage, the most common method of creating water storage capacity along a river, is created by constructing a dam at a suitable site along a river to form an impounded reservoir (e.g., Folsom Reservoir). Additional instream storage may be provided by constructing new reservoirs, by increasing the capacity of existing reservoirs, or by modifying the operations (e.g., flood control reservations) of existing reservoirs. Several existing instream storage reservoirs could be enlarged by building higher dams, and other new reservoir sites such as Auburn Dam have been identified and are being considered in planning studies. At some reservoirs, flood-control reservations could be reduced.

Purpose

New or expanded instream storage is intended to increase the reliability and supply of water by providing increased capacity to store runoff when it is available in excess of downstream needs. Additional instream storage may have fisheries and water quality benefits if seasonal storage allows regulation to provide better and more stable instream flows and cooler temperatures . The additional storage capacity may also improve the reliability of water supplies by allowing for more water to be held as carry-over storage for times of low water availability. Hydropower and recreation benefits may be possible at new reservoir sites and, with expanded reservoir capacities, increased hydropower benefits can be produced at existing power generating facilities.

Constraints

Two major constraints on reservoir construction are: the limited number of appropriate sites, and the environmental impacts associated with construction and operation of reservoirs. New dams may create fish passage barriers that would eliminate upstream spawning and rearing habitat. Enlarging existing reservoirs would have fewer environmental impacts, but because additional areas would be inundated, existing vegetation habitat would be eliminated and recreation development may need to be relocated. The cost of constructing additional instream storage can be very high.

Linkage to Other CALFED Action Categories

The provision of additional instream storage can be linked with watershed management; restoration of upstream riparian habitat, upstream wetland habitat, and upstream anadromous fish habitat; Delta inflow/outflow/export management; and improvements to fish passage and migration. New or expanded instream storage may require an increase in diversion and conveyance capacity to effectively use the available supply and developed storage capacity. In addition, such increases in diversion and conveyance capacities may be required to allow instream storage to facilitate water transfers.

DRAFT

New or Expanded Offstream Storage

Description

New or expanded offstream storage, the creation of water storage capacity in locations away from the sources of water, may include constructing new reservoirs or increasing the capacity of existing reservoirs. Several offstream storage reservoirs are presently in the planning or construction phase, including the Los Vaqueros Reservoir, a project of the Contra Costa Water District; the Domenigoni Valley Reservoir, a project of the Metropolitan Water District of Southern California; Los Banos Grande, a project of the California Department of Water Resources; and the proposed Delta Wetlands project within the Delta.

Purpose

New or expanded offstream storage is intended to increase the reliability and supply of water. The additional storage capacity can also improve the reliability of water supplies by providing flexibility in the timing of diversions. These diversions can be stored when flood water is available and used in times of low water availability. The additional storage may also have water quality benefits, if the extra capacity allows water to be diverted from the source supply when quality is good (generally, during heavier flows).

Constraints

The cost of constructing additional offstream storage can be very high. Also, if the storage site is distant from the water source or the destination, pumping costs can be very high. Two other major constraints are the limited number of appropriate sites for constructing reservoirs and the environmental impacts associated with the construction and operation of reservoirs, conveyance facilities, and pumping stations.

Linkage to Other CALFED Action Categories

The provision of additional offstream storage can be linked to watershed management, increase in diversion capacity, water transfers (that can be managed using offstream storage), groundwater banking and management, construction and improvement of conveyance facilities, Delta inflow/outflow/export management, and changes in locations of diversions. New or expanded offstream storage requires an increase in diversion and conveyance capacity to effectively use the available supply and developed storage capacity. Increases in diversion and conveyance capacities may be required to allow offstream storage to facilitate water transfers.

DRAFT

Groundwater Banking and Management
(Conjunctive Use)

Description

Groundwater is used extensively as a water supply source throughout the state. Groundwater banking and management, using groundwater basins as underground water storage facilities, is often referred to as conjunctive use. Available groundwater storage capacity is used to store excess surface water during wet periods and the additional stored groundwater can be pumped for use during dry periods. Spreading basins or injection wells can be used to increase groundwater recharge. In addition, reclaimed water from water reclamation projects can be used for recharge of groundwater basins.

Purpose

Groundwater storage capacity can be managed to increase the reliability of water supplies by providing flexibility in timing surface-water diversions. A groundwater storage basin provides a buffer for variable surface water supplies, allowing water to be stored during wet periods and extracted during dry periods. Groundwater banking and management north of the Delta could decrease use of surface supplies and thereby increase Delta inflows during periods of below-average water supply. Groundwater banking and management south of the Delta could reduce export needs on the Delta during dry periods by providing alternate storage supplies recharged during previous wet periods.

Constraints

Lack of suitable groundwater basins and lack of access to available surface water supplies during wet periods are two major constraints on groundwater banking programs. The hydrologic characteristics of groundwater basins govern the feasibility of additional recharge and use of storage capacity. Existing groundwater uses (e.g., pumping for agricultural irrigation) must be considered so that fluctuations in water level are not substantially increased. Land subsidence must also be considered. The cost of constructing additional diversion, recharge, and pumping facilities for groundwater banking programs can be very high. Lack of legal protection and institutional arrangements for groundwater management and banking present additional constraints.

Linkage to Other CALFED Action Categories

Groundwater banking can be linked to increases in diversion and conveyance capacity, modifications of diversion timing, water reclamation, water transfers (from north-of-Delta to south-of-Delta groundwater banks), and Delta inflow/outflow/export management. For example, groundwater banking and management may require increases in diversion and conveyance capacity in order to use available surface water during wet periods. In addition, groundwater levels can be stabilized in combination with water transfers and watershed management programs.

DRAFT

Construction and Improvement of Conveyance Facilities

Description

Conveyance facilities include canals, pipelines, siphon-reservoir complexes, and channels, and their intakes and outfalls. The key routes for water conveyance through the Bay-Delta system is from Delta inflow locations to Delta outflow and export locations. Facilities to more efficiently transport water between these endpoints could be located within or around the edges of the Delta. Existing channels such as the Delta Cross Channel could be improved (by being widened, for example). Existing intakes at the Delta export facilities (such as Clifton Court Forebay) could be expanded or otherwise improved. Conveyance facilities are important in south-of-Delta export areas to more efficiently use and conserve water that flows into the Delta.

Purpose

Conveyance facilities can be improved or constructed to more efficiently move water through the Bay-Delta system to better serve water quality and habitat objectives in the Delta. Improvements to existing conveyance facilities and construction of new conveyance facilities contribute to better and more efficient management of water supplies. More direct and/or enclosed conveyance facilities conserve water otherwise lost to seepage, leakage, contamination by salinity intrusion, or evaporation.

Constraints

As with all facilities, cost is a serious constraint for conveyance improvements and construction. Such facilities in the Delta also face serious constraints because of the important aquatic and wetland habitats where they would be sited. Other types of environmental constraints for Delta facility construction are losses of existing land uses, impacts to economic and cultural resources, and impacts to terrestrial habitats. Depending on the size, location (e.g., intakes), and operation of the conveyance facilities, ecosystem health can be adversely affected.

Linkage to Other CALFED Action Categories

Improvements and construction of conveyance facilities can be linked to most other types of actions that might be implemented in the Bay-Delta system and in south-of-Delta use areas. For example, modifications of state and federal water project operations, water conservation, construction of in-stream and offstream storage facilities, facilitation of water transfers, groundwater conjunctive use programs, and Delta inflow/outflow/export management can be combined to more efficiently manage water supplies to benefit all beneficial uses in the Bay-Delta system. Also, construction and improvements of conveyance facilities can be combined with Delta inflow/outflow/export management to improve habitat conditions for fish passage and migration.

DRAFT
Delta Channel Modifications

Description

Channel modifications can consist of deepening, widening and straightening channels, and modifying levees to increase the conveyance of water supply or floodwaters within the Delta, address water quality concerns, and reestablish a net down-estuary flow. Activities can include dredging, creating levee setbacks, and constructing physical barriers and weirs.

Purpose

Channel modifications can contribute to improvements in Delta water supply and water quality conditions by facilitating transfers of Delta inflow to locations for Delta export. Installation of barriers and weirs can be used to modify channel conveyance patterns, for example, to increase transport of high-quality water to areas where it is needed. Alternatively, barriers or weirs can be used to reduce transport of poor-quality water (for example, waters subject to salinity intrusion or contaminated with agricultural drainage) to sensitive locations. Channel modifications can also improve flood control by increasing the capacity to convey flood waters through the Delta.

Constraints

Constraints on channel modifications include land acquisition costs, losses of productive land uses, dredged-material disposal costs and impacts, increases in seepage, blockage or disruption of fish migration patterns, losses and disturbance of important aquatic and wetland habitats (such as shallow riverine habitat and channel tule islands), and mobilization of toxic constituents in dredged materials.

Linkage to Other CALFED Action Categories

Channel modifications can be linked to levee maintenance and stabilization, construction of new flood control protection, construction of conveyance facilities, dredged-material management, and restoration of aquatic and wetland habitats.

Delta channel modifications to increase channel capacity can provide opportunities for the restoration of riparian and shallow water habitats as well as facilitate Delta inflow/outflow/export management.

Water Transfers

Description

Water transfers consist of negotiated agreements between parties that allow water that is typically available or used in one area to be transferred for use in another area. Transfers can occur within a hydrologic basin or between basins, and they can involve the purchase or exchange of water. Three types of transfers are defined in the California Water Code: temporary urgency transfers (less than 1 year), temporary transfers (less than 1 year), and long-term transfers (more than 1 year). Proposals have been made to modify and clarify sections of the California Water Code to facilitate water transfers. Transfers from north-of-Delta to south-of-Delta may require use of available excess diversion and conveyance capacity for wheeling of transferred water.

Purpose

Water transfers are intended to increase the reliability of water supply by reallocating water from areas with excess or unneeded water to areas where demand exceeds supply, either in short-term drought situations or for long-term supplies. Transfers are considered an important tool for solving some of California's water supply and allocation problems, in part because they generally have fewer environmental impacts and costs than construction of new facilities. Water transfers can also directly serve environmental purposes if the water is transferred for use at wildlife reserves, for in-stream flows, or for Delta in-flow or outflow.

Constraints

Large-scale and long-term water transfers could have adverse economic consequences if water is made available for transfer by fallowing farmland. The fallowed land would not require labor and materials for farming, therefore causing secondary effects on "third-party" businesses and local agencies that depend on agriculture. In cases where the party providing the water replaces the transferred supply with groundwater, exacerbation of groundwater overdrafting may occur. Water available for transfer as a result of conservation actions or unneeded supplies in the source area would have fewer economic consequences. Water transfers also may be constrained by legal interpretations and applications of the water rights system and area-of-origin statutes. Transfers also may require transport of water through the Delta and increased diversions to deliver water to the end user. Such increases could require increased Delta export pumping which could affect fish and wildlife. Transfers can be specifically designed, however, to minimize fish and wildlife impacts and take advantage of windows of opportunity to enhance habitat conditions for important fisheries resources.

Linkage to Other CALFED Action Categories

Water transfers can be linked to land fallowing (in source areas), groundwater banking and management, long-term drought contingency planning, Delta inflow/outflow/export management, construction of offstream storage (e.g., use of in-Delta reservoirs to increase flexibility of transfer timing), and establishment of institutional arrangements for long-term water management. Increases in diversion and conveyance capacity and more efficient processing of water transfer agreements are needed to maximize the efficiency of water transfers.

E-000360

DRAFT

Modifications of Standard State Water Project and Central Valley Project Operations

Description

Reservoir operations are largely controlled by flood control objectives in winter, seasonal storage of snowmelt in spring, releases for water supply in summer, and instream flow for fish migration and spawning in fall. Delta operations are largely controlled by water supply exports and water quality objectives (e.g., requirements for Delta outflow). Modifications of standard operations would shift the rules governing operations of reservoir storage and release or they would change the seasonal pattern of Delta inflows and exports to improve Delta water quality or to provide increased fish and wildlife benefits.

Purpose

Modifications in the current State Water Project (SWP) and Central Valley Project (CVP) reservoir and Delta export operations criteria and plans are intended to continue current water supply benefits while providing increased fisheries protection, higher water quality, recreation or other benefits. Modified operations, which can occur without construction or modification of SWP or CVP facilities, require changes in current operating procedures.

Constraints

SWP and CVP project operations are controlled by a wide range of operating capacities, constraints, and objectives. The inflow hydrology during a particular year is the most important variable governing project operations. Only limited flexibility may be available to modify operations in years with low runoff and reduced carry-over storage. Conversely, the flexibility to modify operations to achieve additional fish and wildlife benefits will be greater in years with high runoff and high carry-over storage. The amount of power produced by releases from reservoirs may be affected by changes in project operations.

Linkage to Other CALFED Action Categories

Modifications of standard SWP and CVP operations can be linked to restoration of upstream anadromous fish habitat and Delta inflow/outflow/export management, water transfers from north-of-Delta to south-of-Delta use areas, instream or offstream storage operations, groundwater banking and management, and improvements for fish passage and migration. Such modifications could be implemented within an adaptive management strategy (e.g., based on real-time monitoring of fish movements) to optimize benefits for fish populations. Modified operations could increase opportunities for water transfers to effectively use available water resources.

DRAFT

Installation and Operation of Flow Barriers

Description

Flow barriers are gates or weirs, either fixed or operable, that allow streamflow to be directed between two alternative channels. Inflows to the flood bypass channels along the Sacramento River are controlled by weirs; flow into the Delta Cross Channel is controlled by gates. Flows into Suisun Marsh from the Sacramento River are controlled by tidal gates on Montezuma Slough. Several other weirs or gates have been used or proposed within the Delta. Flow barriers can eliminate flows, limit flows, or provide one-way tidal flow control.

Purpose

Flow barriers may be used for flood, salinity, or fish transport controls and also provide increased water management control. Operation of flow barriers is governed by water management objectives and the relative effects of the flows within alternative channels. For example, the Delta Cross Channel allows increased diversion of Sacramento River water through the Mokelumne River channels toward the Central Valley Project and the State Water Project export pumps, but it may also divert migrating salmon into the central Delta.

Constraints

Depending on how they are operated or designed relative to local hydrodynamic conditions, construction of new flow barriers can have highly variable impacts on water quality, water levels, and aquatic habitat conditions. Proposed large-scale barriers between the Delta and Bay would be extremely expensive and potentially disruptive to the Bay-Delta system. Other small-scale barriers would be much less disruptive but would be constrained by local impacts on water quality, fish movement, and recreational uses. Flow barriers may also restrict recreational use of and access to the Delta.

Linkage to Other CALFED Action Categories

Installation of flow barriers can be linked to channel modifications, Delta inflow/outflow/export management, improvements to fish passage and migration, conveyance facilities, fish screens, installation of barriers to fish movement, predator removal and control, and threatened and endangered species recovery. For example, installation of a flow barrier at the head of Old River in the San Joaquin River may improve fish passage for outmigrating salmon and management of agricultural drainage that enters the San Joaquin River from Salt and Mud sloughs.

DRAFT

Management of Agricultural Drainage

Description

Poor water quality in the Delta and its tributaries has adverse effects on aquatic and wetland organisms and reduces the suitability of Delta exports for urban, industrial, and agricultural uses. Agricultural drainage, both within the Delta and in tributary watersheds, can be managed to improve Delta water quality. Agricultural drainage can be managed by reducing or controlling the volume of discharges, reducing or eliminating concentrations of problem constituents in the drainage, timing the drainage to reduce its impact on the receiving waters, and treating agricultural drainage to remove problem constituents. For example, volumes of agricultural drainage affecting the Delta can be reduced by modifying cropping and irrigation practices to reduce drainage, exporting agricultural drainage to locations outside the Delta watershed and retiring lands that have drainage disposal problems. Concentrations of problem constituents in agricultural drainage can be reduced by improving pest-control practices so as to decrease pesticide use, avoiding use of high-salinity irrigation water, and managing irrigation tailwater to reduce pesticide levels in drainage. Receiving-water impacts can be reduced by managing the timing of discharges to coincide with high Delta inflows to flush poor-quality water through the Delta. Finally, agricultural drainage can be collected and treated to reduce or remove problem constituents.

Purpose

Managing agricultural drainage (and the problem constituents it contains) within the Delta and tributary watersheds benefits the quality of Delta inflows and the Bay-Delta ecosystem in general. Therefore, agricultural drainage management can improve Delta water quality for all beneficial uses.

Constraints

Agricultural drainage management that relies on new facilities (for conveyance, detention, or treatment) would be very costly and would most likely cause diverse environmental impacts at facility locations. Managing drainage by changing agricultural operations may be less expensive but may require institutional and/or regulatory changes to provide sufficient incentives for the changes to be widely implemented.

Linkage to Other CALFED Action Categories

Actions to manage agricultural drainage can be linked with water conservation, water reclamation, land fallowing, Delta inflow/outflow/export management, and construction of flow barriers in the Delta to produce greater water quality benefits in the Bay-Delta system. For example, agricultural drainage management can contribute to aquatic food web productivity by reducing pesticide concentrations in Delta habitats

DRAFT

Management of Urban/Industrial Drainage and Wastewater Discharge

Description

Urban and industrial drainage includes point and nonpoint discharges from urban and industrial facilities, such as wastewater treatment plants, stormwater systems, manufacturing plants, and industrial cooling systems. Management of urban and industrial drainage consists of reducing concentrations of problem constituents in the discharges (through, for example, education and awareness programs for urban residents); reducing the volume of discharges to the Bay-Delta watershed (by, for example, retaining and managing stormwater runoff); or treating the discharges to remove the problem constituents (by, for example, treating wastewater effluent in constructed wetlands).

Purpose

Managing urban and industrial drainage and wastewater discharges improves the water quality of Delta inflows and the Bay-Delta system. Such drainage may contain substances that are directly toxic to aquatic organisms or that accumulate in aquatic and wetland food webs. Urban and industrial drainage may also contain substances such as heavy metals that reduce the quality of water for recreation, such as swimming and fishing, in the Delta. Thus, urban/industrial drainage management can contribute to the health and quality of the Bay-Delta system for aquatic and wetland organisms, water supply, and recreation.

Constraints

Construction and operation of such facilities can create environmental impacts related to disposal of sediments from detention facilities and residues remaining after treatment. Although education and awareness programs and urban growth management to better control nonpoint-source drainage may be less costly, they may also be less effective in managing certain problem constituents. Management of urban and industrial discharges is costly because it usually requires construction of facilities for detention and treatment of drainage waters to remove or reduce problem constituents.

Linkage to Other CALFED Action Categories

Actions to manage urban and industrial drainage can be linked to water conservation among urban and industrial users to help reduce the volume of drainage to the Delta watershed and can be combined with restoration of upstream and Delta wetland habitats to provide final treatment of wastewater treatment-plant effluent for improved Delta water quality.

DRAFT

Dredged Material Management

Description

Managing dredged material involves various measures to reduce adverse impacts of dredging operations and dredged material disposal on chemical and physical conditions of aquatic habitats in the Bay-Delta system. For example, dredging can be timed to occur at slack tides when tidal movement in dredging sites is minimal, thereby retaining suspended particles near the dredged sites. Dredging can also be timed to avoid migration periods of anadromous fish of concern. Techniques, such as silt curtains and suction dredges, can be used to localize sediment movement at dredging sites. Finally, dredged material management can include disposal of dredged material at nonaquatic sites to avoid disposal impacts on aquatic habitats.

Purpose

The purpose of dredged material management is to minimize mobilization of sediments that degrade physical or chemical conditions in aquatic habitats, especially in areas and at times supporting critical life-stages of aquatic species of concern. Dredging mobilizes sediments that possibly contain toxic substances, block fish movement and feeding, and reduce the quality and quantity of shallow water habitat.

Constraints

Disposing of dredged material in nonaquatic sites requires extensive environmental assessment and mitigation efforts to find areas suitable for this activity. Timing dredging operations to better manage dredged material may be constrained by the availability of equipment and labor and the cost of using such resources during only limited portions of a working day or dredging season. Management techniques, such as silt curtains and suction dredges, may be costly where dredging areas and volumes are large. Testing requirements for dredged material and for potential leaching of toxic substances may also be costly.

Linkage to Other CALFED Action Categories

Dredged material management can be linked to channel modifications, conveyance-capacity enhancement, and levee maintenance to improve shallow water habitat restoration to reduce habitat losses from the dredging operations. Dredged material disposal in degraded sites can be used to implement wetland and riparian habitat restoration.

DRAFT

Reduction of Land Subsidence

Description

Land subsidence in the Delta is caused by microbial decomposition of peat soils (oxidation) and physical erosion of interior land surfaces on Delta islands with high proportions of peat soils. As islands subside, the height and width of levees must be increased to maintain structural stability and reliability for flood control. Land use activities that reduce soil moisture and raise soil temperatures promote peat-soil oxidation. By changing current land management practices to those that would maintain high soil moisture levels and low soil temperatures, subsidence of Delta islands can, therefore, be reduced For example, converting intensively cropped agricultural lands to wetlands, riparian woodlands, or water-storage reservoirs would eliminate land subsidence and allow island soil elevations to increase gradually over time through accretion. Also, disposing of dredged material on island interiors would both reduce subsidence and increase elevations of interior islands.

Purpose

Reducing land subsidence on Delta islands can reduce extensive maintenance requirements for levees and increase reliable flood protection for those islands. Levee maintenance costs and risks of levee failure can be reduced by reduction of land subsidence.

Constraints

Reducing land subsidence by either conversion to other land uses or dredged-material disposal requires land use changes in the short term or long term. Such land use changes will limit income-generation potential on these lands and, therefore, may require changes in land ownership. Land acquisition by public agencies to implement such land use changes may be costly. Dredged-material disposal for preventing land subsidence may be limited by the availability of dredged material with suitable physical or chemical properties (e.g., pollutant concentrations) for agricultural production or habitat restoration.

Linkage to Other CALFED Action Categories

Reduction of land subsidence on Delta islands can be linked to wetland and riparian habitat restoration, levee maintenance and stabilization, reduction of seismic hazards for flood control facilities, management of agricultural drainage from Delta islands, offshore water storage on Delta islands, and management of dredged materials. These actions can be combined to improve ecosystem quality, water quality, and system reliability for the Bay-Delta system. Reduction of land subsidence and levee maintenance and stabilization can be combined with restoration of Delta habitats to provide corridors for diverse wildlife species.

DRAFT

Levee Maintenance and Stabilization

Description

Levee maintenance and stabilization increases the reliability and stability of existing levees that provide flood protection for Delta islands. Levee maintenance and stabilization actions therefore consist of actions such as adding berms, widening levees, placing stone protection, or keeping the levee clear of vegetation. Also, institutional arrangements could be established to ensure funding so that levees are rehabilitated and maintained to uniform standards.

Purpose

Levee maintenance and stabilization contribute to maintaining the reliability of the Bay-Delta system and protecting its beneficial uses. Reliability of existing flood control facilities around Delta islands protects existing land uses for agriculture, wildlife habitat, and infrastructure such as transportation facilities, gas transmission lines, and water conveyance systems. Levee reliability in the western Delta is also crucial to protecting Delta water quality from salinity intrusion that can result from island inundation.

Constraints

Lack of funding and habitat impacts are major constraints to levee maintenance and stabilization actions. Aquatic habitats provide important habitat features for both aquatic and wetland ecosystems. Both direct maintenance and rehabilitation of levees and establishment of comprehensive institutional arrangements to ensure these actions are implemented would be costly. Thus, levee maintenance and rehabilitation projects need to be designed to address potential impacts to habitats.

Linkage to Other CALFED Action Categories

Levee maintenance and stabilization actions can be linked for combined positive benefits to actions in categories such as reduction of land subsidence (to reduce depths of island interiors under protection), construction of conveyance facilities and channel modifications in the Delta to achieve water supply or water quality purposes, management of dredged materials (for example, as a source of levee construction material), restoration of riparian and wetland habitats, establishment of long-term funding mechanisms for levee maintenance, and regional land use planning.

For example, levee maintenance and stabilization could be combined with establishment of floodways and habitat restoration to create corridors for wildlife movement between Delta habitats.

DRAFT
Flood Protection Improvement

Description

Improving flood protection systems and facilities consists of actions to increase the level of flood protection above that currently provided. For example, a current levee system may provide protection with a probability of flooding in any one year of 1 in 100; that system could be improved to provide protection with a probability of flooding in any one year of 1 in 200. Actions to improve flood protection may include rebuilding levees to higher design standards (e.g., freeboard and cross-section), raising levees to contain higher floodstages, widening floodways to provide more conveyance capacity, and providing overflow areas to manage peak discharges without damaging property or infrastructure.

Purpose

Improving flood protection levels would better maintain the reliability of the Bay-Delta system and protect its beneficial uses. Flood control systems protect existing land for use in agriculture and as wildlife habitat and protect infrastructure, such as transportation facilities and gas transmission lines. Levee reliability in the western Delta is also crucial for protecting Delta water from salinity intrusion resulting from island inundation.

Constraints

Flood-control system improvements to increase levels of protection can cause a wide array of environmental and economic impacts on Delta land uses and aquatic and terrestrial resources if they are not properly integrated. Such improvements would be extremely costly because they would often entail substantial construction and mitigation requirements. Actions to enlarge, move, or relocate levees and flood control features would require land acquisition and disruption of land uses. Lack of long-term funding and institutional support for comprehensive flood protection improvements are severe constraints to this category of actions. Potential conflicts with protection of sensitive species and habitats are also constraining.

Linkage to Other CALFED Action Categories

Improving flood control systems and levels of flood protection can be linked with actions to restore habitats and improve water supply reliability. For example, flood control improvements can be combined with establishing floodways and meander belts, restoring mosaics of Delta habitats, reducing land subsidence, channel improvements, improving conveyance facilities, and protection and rerouting of infrastructure to provide greater overall benefits to uses of the Bay-Delta system. Implementing flood control improvements may require that long-term funding mechanisms be established, possibly in combination with establishing an institution for integrated long-term water management in the Delta.

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